CLAIMS

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is as follows:

1. A computerized method of linear algebra processing, said method comprising:

processing a matrix data of a triangular packed format matrix in at least one matrix subroutine designed to process matrix data in a full format, using a hybrid full-packed data structure,

wherein said hybrid full-packed data structure provides a rectangular data structure for said triangular packed data.

2. The method of claim 1, further comprising:

converting said matrix data from said triangular packed format into said hybrid full-packed data structure.

3. The method claim 1, wherein said hybrid full-packed data structure comprises:

a square portion of said triangular packed data;

a first triangular portion of said triangular packed data; and

a second triangular portion of said triangular packed data,

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wherein said square portion, said first triangular portion, and said second

triangular portion are fitted together to form said rectangular data structure.

4. The method of claim 1, wherein said at least one matrix subroutine designed to

process matrix data in said full format comprises at least one of a packed

triangular matrix subroutine and a symmetric matrix subroutine of a LAPACK

(Linear Algebra PACKage) software package.

5. The method of claim 4, wherein said at least one matrix subroutine comprises a

variant of a corresponding full format routine of a LAPACK level 3 BLAS (Basic

Linear Algebra Subroutine).

6. The method of claim 5, wherein said level 3 BLAS comprises an L1 kernel

routine,

wherein L1 comprises an L1 cache in a computer, said L1 cache

comprising a cache closest to one of a CPU (Central Processing Unit) and an FPU

(Floating-Point Processing Unit) in said computer.

7. The method of claim 2, wherein said converting comprises:

    determining a portion of said matrix data stored in said triangular packed

format that would comprise a square portion having a dimension approximately

one half a dimension of said triangular packed format.

8. The method of claim 7, further comprising:

    fitting a first triangular portion of said matrix data stored in said triangular

packed format into a first location relative to data of said square portion; and

    fitting a second triangular portion of said matrix data stored in said

triangular packed format into a second location relative to data of said square

portion,

    wherein said first triangular portion, said second triangular portion, and

said square portion fit together to form said rectangular data structure.

9. The method of claim 1, further comprising:

    converting a result of said processing of matrix data from said hybrid

full-packed data structure into a triangular packed data format.

10. An apparatus for linear algebra processing, said apparatus comprising:

a processor for processing a matrix data of a triangular packed format matrix in at least one matrix subroutine designed to process matrix data in a full format, using a hybrid full-packed data structure,

wherein said hybrid full-packed data structure provides a rectangular data structure for said triangular packed data.

11. The apparatus of claim 10, further comprising:

a receiver for receiving said matrix data in said triangular packed format, said processor further converting said matrix data received in said triangular packed format into said hybrid full-packed data structure.

12. The apparatus of claim 10, wherein said hybrid full-packed data structure comprises:

a square portion of said triangular packed data;

a first triangular portion of said triangular packed data; and

a second triangular portion of said triangular packed data,

wherein said square portion, said first triangular portion, and said second triangular portion are fitted together to form said rectangular data structure.

13. The apparatus of claim 10, wherein said at least one matrix subroutine designed to process matrix data in a full format comprises at least one level 3 BLAS (Basic Linear Algebra Subroutine) matrix subroutine of a LAPACK (Linear Algebra PACKage) software package.

14. The apparatus of claim 13, wherein said processor comprises one of a CPU (Central Processing Unit) and an FPU (Floating-Point Processing Unit), said apparatus further comprising:

an L1 cache, said L1 cache comprising a cache closest to said CPU or said FPU,

wherein said level 3 BLAS comprises an L1 kernel routine.

15. A signal-bearing medium tangibly embodying a program of machine-readable instructions executable by a digital processing apparatus to perform a method of processing a matrix data of a triangular packed format matrix in at least one matrix subroutine, using a hybrid full-packed data structure,

wherein said hybrid full-packed data structure provides a rectangular data structure for said triangular packed data.

16. The signal-bearing medium of claim 15, said machine-readable instructions further comprising instructions to convert said matrix data from said triangular packed format into said hybrid full-packed data structure.

17. The signal-bearing medium of claim 15, wherein said hybrid full-packed data structure comprises:

a square portion of said triangular packed data;

a first triangular portion of said triangular packed data; and

a second triangular portion of said triangular packed data,

wherein said square portion, said first triangular portion, and said second triangular portion are fitted together to form said rectangular data structure.

18. A method of at least one of solving and applying a scientific/engineering problem, said method comprising at least one of:

using a linear algebra software package that computes one or more matrix subroutines, wherein said linear algebra software package processes a matrix data of a triangular packed format matrix in at least one matrix subroutine, using a full-packed data structure,

wherein said hybrid full-packed data structure provides a rectangular data structure for said triangular packed data;

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providing a consultation for solving a scientific/engineering problem using said linear algebra software package;

transmitting a result of said linear algebra software package on at least one of a network, a signal-bearing medium containing machine-readable data representing said result, and a printed version representing said result; and

receiving a result of said linear algebra software package on at least one of a network, a signal-bearing medium containing machine-readable data representing said result, and a printed version representing said result.

19. The method of claim 18, wherein said linear algebra software package comprises a Linear Algebra PACKage (LAPACK) software package.

20. The method claim 18, wherein said hybrid full-packed data structure comprises:

a square portion of said triangular packed data;

a first triangular portion of said triangular packed data; and

a second triangular portion of said triangular packed data,

wherein said square portion, said first triangular portion, and said second triangular portion are fitted together to form said rectangular data structure.

21. A computerized method of converting data in a triangular matrix into a rectangular data format, said method comprising:

determining a portion of said matrix data stored in said triangular packed format that would comprise a square portion having a dimension approximately one half a dimension of said triangular packed format.

22. The method of claim 21, further comprising:

fitting a first triangular portion of said matrix data stored in said triangular packed format into a first location relative to data of said square portion; and

fitting a second triangular portion of said matrix data stored in said triangular packed format into a second location relative to data of said square portion,

wherein said first triangular portion, said second triangular portion, and said square portion fit together to form said rectangular data structure.

23. A data structure in a computer program used for processing matrix data, said data structure used to store a matrix data from a triangular matrix format, said data structure providing a rectangular structure for said data from said triangular matrix said data structure comprising:

a first portion forming a square portion, said square portion including said matrix data stored in said triangular packed format that would comprise a square

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portion having a dimension approximately one half a dimension of said triangular packed format;

a second portion forming a first triangular portion, said first triangular portion including a first triangular matrix data stored in said triangular packed format that remains after said square portion is eliminated; and

a third portion forming a second triangular portion, said second triangular portion including a second triangular matrix data stored in said triangular packed format that remains after said square portion and said first triangular portions are eliminated,

wherein said data structure fits together said first portion, said second portion, and said third portion to form a rectangular data structure.

24. A method of providing a service, said method including at least one of:

at least one of solving and applying a scientific/engineering problem in accordance with the method of claim 18; and

providing a consultation using a method in accordance with claim 18.

25. A method of at least one of saving memory space in a computer performing linear algebra processing and saving time in said processing, said method comprising:

converting a matrix stored in a full format into a triangular format; and

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converting said triangular format into a hybrid full-packed data structure,

wherein said hybrid full-packed data structure provides a rectangular data

structure for said triangular format.